Rejections under 35 U.S.C. §103:

Claims 1-3 have been rejected under 35 U.S.C. §103 as being unpatentable over Tabata et al. in view of Ueyama et al.

Claim 1 recites a robotic arm structure including at least two links and an end effector attached to a distalmost link and being rotatable about an end effector axis. A motor is connected to rotate the end effector about the end effector axis to thereby provide a yaw motion of the end effector. Means are provided for monitoring and controlling the yaw motion such that the end effector can be moved in a straight line which is not restricted to the radial direction.

The ability of the end effector to be moved in a straight line which is not restricted to the radial direction provides a distinct advantage over the prior art. In particular, the prior art substrate processing systems were limited to either 1) processing stations arranged in a row and loaded by a robot which travels on a track parallel to the row of processing stations, or 2) processing stations arranged in a circle around a rotating robot. These arrangement limitations were due to the fact that the end effectors of the robots where all designed to move forward and backward along a path which extends radially from a central axis of the robot arm. Moving the end effector in a straight line is particularly important when moving substrates into and out of cassettes and processing stations in order to guarantee proper insertion and removal. This is particularly important for rectangular objects such as flat panel displays.

Tabata, et al. has been cited as a teaching of a robot controller that moves a two joint robot in off-axis linear motion. Tabata, et al. discloses a method for controlling the location of a robot arm to reach a desired position in a minimum time. However, Tabata, et al. does not disclose an end effector. Further, if a conventional end effector was placed on the robot of Tabata, et al. this end effector would not have the requisite controls to allow the end effector to move in a straight line which is not restricted to the radial direction.

Ueyama, et al. has been cited as teaching the use of an end effector. However, the end effectors described and shown in Ueyama, et al. travel only in the radial direction. For

example, the two handlers 30a and 30b are mounted on a guide rail 43 and move along the guide rail to access the different process chambers shown in FIG. 2. (col. 7, lines 1-4). The handler 30a which is shown in further detail in FIG. 6 moves forwardly and backwardly when driven by the motor (col. 8, lines 40-41) with the end effector traveling in the radial direction only. Another arm mechanism 140 shown in FIG. 14 of Ueyama, et al. includes hands 150a and 150b which move in the Y direction in a radial path to reach the process unit. (col. 14, lines 19-22).

Neither Tabata, et al. or Ueyama, et al., alone or in combination, teach or suggest a motor connected to rotate an end effector about the end effector axis to thereby provide a yaw motion, and means for monitoring and controlling the yaw motion such that the end effector can be moved in a straight line which is not restricted to the radial direction. Accordingly, Claim 1 and claims 2-7 depending from claim 1 are allowable over the combination of Tabata, et al. and Ueyama, et al.

Claims 4, 6, and 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Tabata, et al. in view of Ueyama, et al. and further in view of Nishida, et al. In addition, Claim 5 has been rejected under 35 U.S.C. §103 as being unpatentable over Tabata, et al. in view of Ueyama, et al. and further in view of Tateyama, et al.

Nishida, et al. has been cited as a teaching of a robotic system that uses a conveyor belt. Tateyama, et al. has been cited for a disclosure of a wafer processing device having two separate robot arms exchanging wafers at a waiting section accessible to both robots. As discussed above, Tabata and Ueyama fail to disclose the motion of an end effector in a straight line which is not restricted to a radial direction. Nishida, et al. and Tateyama, et al. also do not disclose an end effector which travels in a straight line in a non-radial direction. Tateyama, et al. discloses a track mounted robot with a radially moving end effector which operates in a manner similar to that of Ueyama, et al. Accordingly, claims 4-7 are allowable.

Claims 15-17 and 19 have been rejected under 35 U.S.C. §103 as being unpatentable over Ueyama, et al. in view of Herzog and Tabata, et al.

Claim 15 defines a robotic arm mechanism having a frogs leg type linkage. Examples of frogs leg type linkages are illustrated in FIGS. 10-16 of the present application. A frogs leg type linkage includes two distal links pivotally connected together at their distal ends. The distal links are each pivotally connected to proximal links at elbows and the proximal links are pivotally connected to a base or support. As recited in Claim 15 and shown most clearly in FIGS. 15A and 15B, the proximal links are pivotally connected to the support in spaced apart relation to one another. This configuration as claimed in FIG. 15 allows the end effector to access a plurality of different cassettes 605 and workstations 606 which are not arranged radially around the center of the robotic arm mechanism.

None of the prior art applied teaches or suggests a frogs leg type linkage as claimed in Claim 15. Further, none of the prior art teaches that the proximal links of a frogs leg type linkage are pivotally connected to a support in a space apart relation to one another.

Herzog shows in FIG. 10, a measuring apparatus having a configuration in which two links are pivotally attached to a base at a space apart arrangement. However, the opposite ends of these two links are connected to one another rather than pivotally connected to distal links. Thus, Herzog achieves none of the advantages of a frogs leg type robotic arm mechanism. For at least these reasons, Claims 15-17 and 19 are clearly allowable over Ueyama, et al. in view of Herzog and Tabata, et al.

Claim 18 has been rejected under 35 U.S.C. §103 as being unpatentable over Ueyama, et al. in view of Herzog and Tabata, et al. and Genov, et al. Genov, et al. has been cited as teaching the use of belts. Genov, et al. does not supply any of the deficiencies of the patents described above because Genov, et al. does not teach a frogs leg type linkage. Accordingly, Claim 18 is allowable.

Claims 31, 35, 39, and 44-48 have been rejected under 35 U.S.C. §103 as being unpatentable over Tabata, et al. in view of Ueyama, et al. and Corwin, Jr., et al.

Independent Claims 31, 35, and 39 relate to robotic arm structures with end effectors for transporting semiconductor substrates which are attached to the arm structure. The end effectors are rotatable by a first motor to provide a yaw motion and rotatable by a second motor to provide a roll or pitch motion. This provides the advantage of being able to align the end effector properly with a semiconductor substrate to be moved.

Corwin, Jr., et al. has been cited as disclosing a function element 34 shown in FIG. 1 with three degrees of freedom. However, the robot and grasper for grasping and moving objects disclosed in Corwin, Jr., et al. differs from those devices used for transporting semiconductor substrates. In particular, devices for transporting semiconductor substrates such as those shown in Ueyama, et al. include a substrate transporting end effector or paddle which is inserted beneath a substrate and lifts the substrate to remove it from a cassette or workstation. However, as described in the present application, semiconductor substrates and particularly large panel displays may be misaligned at a substrate processing station or in a cassette. In the case of misaligned substrates or misalignment between processing stations or cassettes it would be advantageous to provide an end effector which is capable of adjustment to accommodate the misalignment.

The prior art does not teach or suggest a substrate transporting end effector which is rotatable in two dimensions to provide alignment with a semiconductor substrate. Accordingly, independent Claims 31, 35, and 39 are allowable.

Claims 44 and 45 are allowable for the following additional reasons. Claim 44 recites the robotic arm structure of Claim 31 in which the end effector has at least two hands such that the second motor rolls a first hand and a third motor rolls a second hand. Although robotic arm structures having multiple end effectors are described in the prior art, none of the prior art teaches or suggests a first motor which provides yaw motion, a second motor which provides roll motion of a first hand a third motor which provides roll motion of a second hand. Accordingly, Claims 44 and 45 are clearly allowable.

Claim 48 recites an end effector having at least two hands such that the second motor pitches a first hand and a third motor pitches a second hand. This configuration is also not taught or suggested by the prior art, and Claim 48 is allowable for this additional reason.

New Claims 49 and 50 have been added to further define the motion of the end effector in the invention of Claim 1. As recited in Claim 50, the robotic arm is capable of moving the end effector in such a way that any given point on the end effector can move in a straight line and the end effector is kept at the same orientation for proper substrate insertion in a cassette or process station. Claims 49 and 50 are allowable for at least the same reasons discussed above with respect to Claim 1.

Reconsideration and allowance of the above-identified application are respectfully requested. In the event that there are any questions concerning this amendment, or the application in general, the Examiner is respectfully urged to telephone the undersigned attorney so that prosecution may be expedited.

Respectfully submitted,
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